

# Strengthening Surgical Care through Adoption of the World Health Organization Surgical Safety Checklist: A prospective cohort study

ElMuhtadi B. Y. Gasoma (✉ [elmuhtadi4@gmail.com](mailto:elmuhtadi4@gmail.com))

Ribat University Hospital <https://orcid.org/0000-0002-9435-5616>

Mohamed A. Marouf (✉ [marouf79@gmail.com](mailto:marouf79@gmail.com))

Ribat University Hospital

---

## Research Article

**Keywords:** Surgical Checklist, Surgery, Surgical Complications, Sign in, Time out, Sign out

**DOI:** <https://doi.org/>

**License:**   This work is licensed under a Creative Commons Attribution 4.0 International License.

[Read Full License](#)

---

## Abstract

### Background:

Globally, surgical care plays a vital role in healthcare. Unfortunately, complications arise in approximately 5-18% of surgical procedures. However, research has shown that following the surgical safety checklist provided by the World Health Organization (WHO) can significantly reduce these complications and surgery-related fatalities. The objective of this study was to assess the accuracy and completion of the WHO Surgical Safety Checklist.

### Method:

From September 3, 2022, to February 28, 2023, a comprehensive observational study was conducted involving 300 patients who underwent elective and emergency surgeries. The completion rates for the different stages of surgery, namely sign-in, time-out, and sign-out, were determined using the SPSS 22.0 software.

### Result:

In our research, we specifically examined the completion of the checklist for 300 patients who underwent important procedures within a span of five months. For each patient, we ensured that their identities, procedures, and consent were verified with a 100% success rate. Additionally, we thoroughly checked the anesthesia equipment and drugs for safety in every case. Furthermore, all essential images were consistently displayed for each patient, achieving a 100% adherence to this crucial aspect of the process.

### Conclusion:

In general, the level of completeness of the checklist was satisfactory across the sign-in, time-out, and sign-out phases. While this study did not assess the specific outcomes, it is presumed that incomplete data may have exposed patients to potential perioperative complications.

Key Words: Surgical Checklist, Surgery, Surgical Complications, Sign in, Time out, Sign out

## Introduction

Surgical procedures are a vital part of health care around the world, with about 234 million operations performed every year [1,2]. This number is higher than the number of births each year [3]. However, surgery also carries a risk of complications, which happen in 5-18% of cases [4,6]. These complications can lead to serious harm or death for patients, affecting one out of every 310 operations [5,7,8]. Therefore, it is important to prevent medical errors as much as possible [7]. One way to do this is to use the WHO Surgical Safety Checklist, which is a global tool to improve patient safety during surgery [9]. The checklist covers the essential aspects of surgical care, such as infection prevention, anaesthesia safety, teamwork and communication, and quality measurement [10,11]. There is strong evidence that nearly half of the complications or adverse outcomes resulting from surgical operations can be avoided [11,12]. Studies have shown that using the checklist can reduce the rate of major complications from 11% to 7% and reduce the rate of mortality by 53% (from 1.5% to 0.8%) [2,7]. The checklist has four main components that correspond to different stages of the surgical process [13]. The use of the checklist (following all four components) has increased over time and has been associated with lower rates of postoperative problems and mortality [14,15]. However, the effectiveness of the checklist depends on how well it is implemented in each hospital. Some challenges include integrating it into the workflow and measuring its impact on safety [16]. To ensure successful implementation, hospital leaders and staff need to be actively involved in the process, communicate and collaborate across disciplines, provide training and feedback, and conduct regular audits [2,14,15,17,20]. It has been shown that there is a direct link between better outcomes and the use and adherence to the checklist [21]. Therefore, to achieve the full benefits of the checklist, it is necessary to ensure proper compliance and implementation. The purpose of this study is to evaluate how well the WHO checklist is completed at Ribat University Hospital operating room.

## Aims and objectives

### Aim

The aim of this study was to assess the completion of all the surgery checks and briefing/debriefing for each operative and surgical procedure at Ribat University Hospital.

### Objectives

The main objectives of this study are:

1) To identify the missing steps in completing the surgical safety checklist 2) To ensure that the right patient and the right site are operated on by the OR team 3) To enhance the safety of anesthesia practices 4) To prevent infections at the surgical site and 5) To facilitate good communication among the OR team.

## Methods

A prospective observational cohort study was conducted at Ribat University Hospital from September 03, 2022 to February 28, 2023

### Audit population

All surgical procedures done at Ribat University Hospital.

### Audit sample

All surgical procedures done during the study period.

### Data collection method and analysis

The information was collected by direct observation and a checklist-based chart review. The audit proforma was created by converting the standards into question forms with the integrated checking options "Yes" and "No". Google

Forms were used to enter the data, which were then exported into SPSS version 22.0 for analysis. Descriptive analysis was performed. Results are expressed in frequencies and percentages using table and figure. The work has been reported in line with the STROCSS criteria [22].

## Audit standards

The WHO has created a worldwide surgical safety checklist to reduce the frequency of surgical complications by strengthening the commitment of clinical professionals to address safety issues in surgical settings. The checklist is divided into three sections: before induction of anesthesia, before skin incision, and before any team member exits the operating room. The gold standard was a 100% completion rate of high-quality, safe surgery checks before each operation or surgical procedure (Table 1).

**Table 1 :** Standards of surgical safety drafted by WHO.

	<b>Standards</b>	<b>Target</b>	<b>Evidence</b>	<b>Data source</b>	<b>Exception</b>
	<b>Part I:</b> Before induction of anaesthesia				
1	Confirm patients' identity, procedure and consent	100%	WHO guidelines	Direct observation/intern	
2	Mark surgical site	100%	»	»	
3	Check anaesthesia machine and medications	100%	»	»	
4	Known allergy	100%	»	»	
5	Difficult airway/aspiration	100%	»	»	
6	Risk of bleeding > 500 ml	100%	»	»	7 ml/kg in children
	<b>Part II</b> Before start of surgical incision				
7	All team members introduce themselves by name and role	100%	»	»	
8	Surgeon, anesthetist and registered practitioner confirm verbally planned procedure, site and position	100%	»	»	
9	Critical/ unanticipated steps the surgeon may announce to the team	100%	»	»	
10	Patient specific concern for anesthetist	100%	»	»	
11	Nurses confirmation about the sterility of instrumentation	100%	»	»	
12	Antibiotic prophylaxis within the last 60 min	100%	»	»	
13	Essential imaging displayed	100%	»	»	
	<b>PART I</b> Before any member of the team leaves the operating room				
14	Nurse verbally confirms name of procedure	100%	»	»	
15	Confirm instruments, swabs and sharps counts are complete	100%	»	»	
16	Specimens labelled by patient name	100%	»	»	No specimen
17	Any equipment problem need to addressed	100%	»	»	If all equipment's functional
18	Report key concerns for the recovery room professionals	100%	»	»	

## Result

We examined the completion of the checklist for 300 patients who underwent major operations in six months in our study. The identity, procedure and consent of all patients (100%) were verified as the standard requires in its first part (before anaesthesia was administered). The anaesthesia machine and medications were also scrutinized for safety for all patients. The allergic status of the patient was queried and documented in 97.01% of the patients. Essential images were displayed for all patients (100%). (Table 2). The highest completeness of the checklist was seen in February and the lowest completeness of the checklist was seen in September (Figure 1).

Table 2 : Completed and missed items in the checklists over the six months analyzed.

	<b>Standards</b>	<b>Complete</b>	<b>%</b>	<b>Missed</b>	<b>%</b>
<b>Part I: Sign in</b>					
1	Confirm patients' identity, procedure and consent	300	100	0	0
2	Mark surgical site	294	98,04	4	1,96
3	Check anaesthesia machine and medications	300	100	0	0
4	Known allergy	291		9	2,99
5	Difficult airway/aspiration	291		9	2,96
6	Risk of bleeding > 500 ml	289	96,5	11	3,5
<b>Part II Time out</b>					
7	All team members introduce themselves by name and role	271	90,4	29	9,6
8	Surgeon, anesthetist and registered practitioner confirm verbally patient name, planned procedure, site and position	294	98,2	6	1,8
9	Critical/ unanticipated steps the surgeon may announce to the team	282		18	5,97
			94,03		
10	Patient specific concern for anesthetist	286	95,4	14	4,6
11	Nurses confirmation about the sterility of instrumentation	290	96,7	10	3,3
12	Antibiotic prophylaxis within the last 60 min	281	93,8	19	6,2
13	Essential imaging displayed	300	100	0	0
<b>PART I Sign out</b>					
14	Nurse verbally confirms name of procedure	271	90,5	29	9,5
15	Confirm instruments, swabs and sharps counts are complete	287	95,8	13	4,2
16	Specimens labelled by patient name	294	98,2	6	1,8
17	Any equipment problem need to addressed	283	94,5	17	5,5
18	Report key concerns for the recovery room professionals	279	93,1	21	6,9

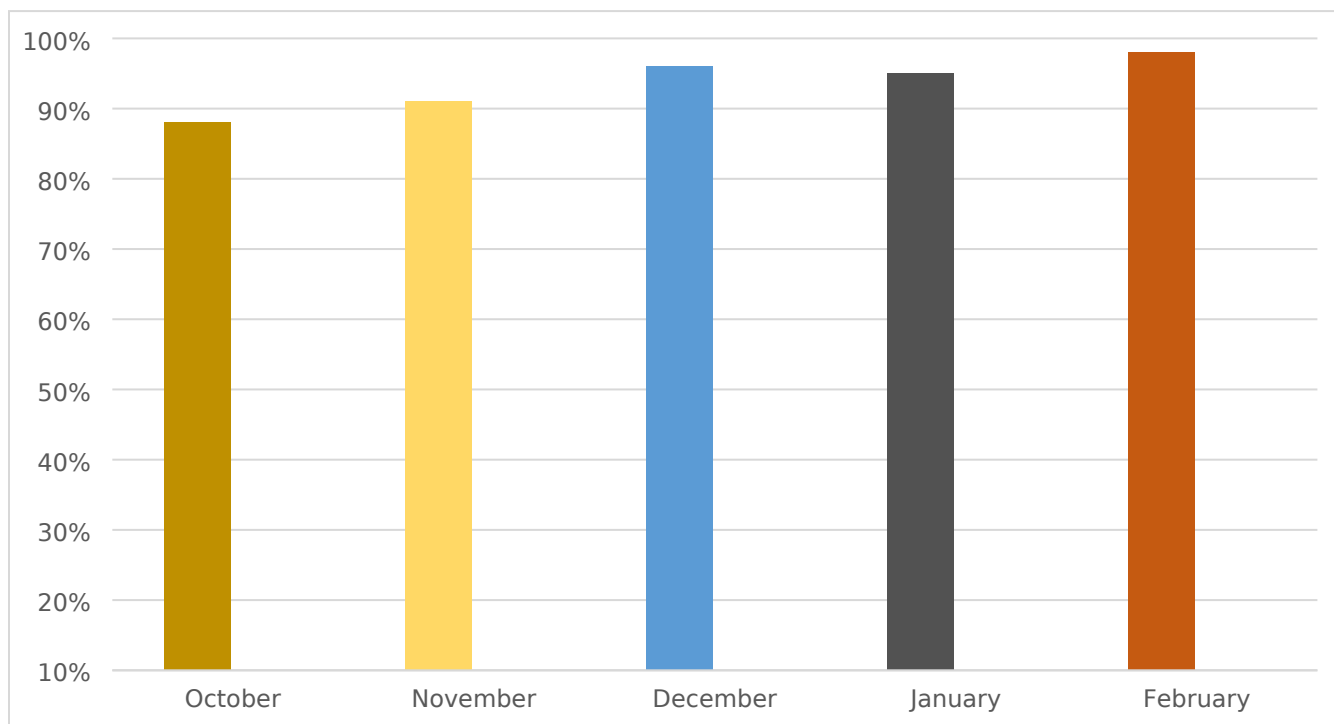


Figure 1. Checklist completions by month during implementation

## Discussion

The WHO checklist has three main parts, which are done at specific times during surgery: The first part (Sign-in) is before giving anesthesia to the patient; the second part (Time-out) is before making the surgical incision; and the third part (Sign-out) is before transferring the patient to the recovery room [Figure. 2]. Important information can be reviewed, shared, and communicated between all team members involved in surgery at each of these times. The checklist is meant to improve surgical outcomes and, as a result, healthcare quality in general. However, its introduction and sustainability are always a big challenge. The Sign-in period was more completed than the Time-out and Sign-out periods in this study. These items are important in avoiding the most common mistakes that seriously harm patients [11]. This finding is almost similar to a study done in India [6]. In addition, confirming patients' identity, procedure and consent were 100% completed. This finding is nearly the same as a study done at the University of Gondar in Ethiopia, where only 1.9% was missed in their study [5]. In the current study, the anaesthesia machine and medications check were completed in all patients. This finding is almost consistent with a study done at Yekatit 12 referral Hospital, Addis Ababa, Ethiopia [23]. However, even though they are essential steps, items of aspiration risk, anticipation of a difficult airway, and estimated blood loss were not checked in some cases; all of them could cause death [24]. One of the WHO Surgical Safety Checklist's main goals is to encourage communication among the surgical team [25]. In the Time-out period, surgical teams are supposed to mention their name and role to each other. In this period, some surgical team members did not mention their name and role to the others. However, this finding is higher than a study done in Thailand in which the majority of the surgical team failed to introduce their name and functional role to others [25]. Essential imaging was displayed during surgery in all patients. This finding is almost in line with studies conducted in different institutions [5,6,25,26]. In this study finding, the Sign-out period was less performed compared with other sections. However, this finding is higher than most study findings conducted in different study areas [5,10,26,27]. The presence of adequate operating room nurse staff, which reduces the workload of nurses needed to prepare for subsequent procedures, may be the cause of this disparity.

# Surgical Safety Checklist



World Health Organization

Patient Safety  
A World Alliance for Safer Health Care

Before induction of anaesthesia	Before skin incision	Before patient leaves operating room
(with at least nurse and anaesthetist)	(with nurse, anaesthetist and surgeon)	(with nurse, anaesthetist and surgeon)
<p><b>Has the patient confirmed his/her identity, site, procedure, and consent?</b></p> <input type="checkbox"/> Yes	<p><input type="checkbox"/> <b>Confirm all team members have introduced themselves by name and role.</b></p> <p><input type="checkbox"/> <b>Confirm the patient's name, procedure, and where the incision will be made.</b></p> <p><b>Has antibiotic prophylaxis been given within the last 60 minutes?</b></p> <input type="checkbox"/> Yes <input type="checkbox"/> Not applicable	<p><b>Nurse Verbally Confirms:</b></p> <input type="checkbox"/> The name of the procedure <input type="checkbox"/> Completion of instrument, sponge and needle counts <input type="checkbox"/> Specimen labelling (read specimen labels aloud, including patient name) <input type="checkbox"/> Whether there are any equipment problems to be addressed
<p><b>Is the site marked?</b></p> <input type="checkbox"/> Yes <input type="checkbox"/> Not applicable	<p><b>Anticipated Critical Events</b></p> <p><b>To Surgeon:</b></p> <input type="checkbox"/> What are the critical or non-routine steps? <input type="checkbox"/> How long will the case take? <input type="checkbox"/> What is the anticipated blood loss? <p><b>To Anaesthetist:</b></p> <input type="checkbox"/> Are there any patient-specific concerns? <p><b>To Nursing Team:</b></p> <input type="checkbox"/> Has sterility (including indicator results) been confirmed? <input type="checkbox"/> Are there equipment issues or any concerns?	<p><b>To Surgeon, Anaesthetist and Nurse:</b></p> <input type="checkbox"/> What are the key concerns for recovery and management of this patient?
<p><b>Is the anaesthesia machine and medication check complete?</b></p> <input type="checkbox"/> Yes	<p><b>Is essential imaging displayed?</b></p> <input type="checkbox"/> Yes <input type="checkbox"/> Not applicable	
<p><b>Is the pulse oximeter on the patient and functioning?</b></p> <input type="checkbox"/> Yes		
<p><b>Does the patient have a:</b></p> <p><b>Known allergy?</b></p> <input type="checkbox"/> No <input type="checkbox"/> Yes		
<p><b>Difficult airway or aspiration risk?</b></p> <input type="checkbox"/> No <input type="checkbox"/> Yes, and equipment/assistance available		
<p><b>Risk of &gt;500ml blood loss (7ml/kg in children)?</b></p> <input type="checkbox"/> No <input type="checkbox"/> Yes, and two IVs/central access and fluids planned		

This checklist is not intended to be comprehensive. Additions and modifications to fit local practice are encouraged.

Revised 1 / 2009

© WHO, 2009

Figure 2. WHO Safe surgery checklist.

## Strengths of the study

This study offers some advantages of its own. First, all hospital surgical departments were considered. Second, the research tool was adjusted to fit the environment. Third, it was translated into Arabic so that everyone on the surgical team could understand it. Fourth, all levels of surgical teams cooperated. Fifth, the researcher rechecked the data after they were collected by skilled surgical team members.

## Limitation of the study

The study was conducted in only one setting and in a brief period of time; therefore, the results might not be applicable to other settings throughout the country.

## Conclusion

While checklists have the potential to enhance surgical safety, their effectiveness depends on how well they are implemented. The overall completeness of the checklist in the sign-in, time-out, and sign-out periods was satisfactory. Furthermore, healthcare professionals have recognized the usefulness of using the checklist frequently during

emergency cases. To promote more regular usage and enhance communication, additional training and focus on actual checklist utilization are recommended.

#### Recommendation

Checklists serve as a valuable tool to boost teamwork, enhance patient safety, and foster effective communication within a team. It's important for team members to actively utilize the checklist during their work routines to ensure consistency. It is also crucial to create awareness, specifically for new nursing and anesthetic staff, about the importance of using the checklist regularly. Furthermore, by conducting frequent audits to track checklist usage, providing ongoing training and refresher sessions to improve communication, compliance with the checklist can be enhanced. To encourage regular utilization of this valuable tool, it is recommended to prioritize training efforts and emphasize the significance of adhering to the checklist.

#### Ethical approval

- The ethical approval was obtained from the ethics committee of Ribat University Hospital authority on 11/8/2022 no.111/33
- Experimental protocols were approved by Ribat University Hospital authority licensing committee and the study protocol were performed in accordance with the relevant guidelines applied at the hospital.
- The data used in the study is anonymized.

#### Funding

The study was self-funded.

#### Conflict of interest statement

No conflict of interest to declare.

#### Author contributions

1. ElMuhtadi B. Y. Gasoma ( First Author ) : Involved in study design, data acquisition, drafting the article, revising it critically and finally approved the manuscript.
2. Mohamed A. Marouf ( Co-Author ) : Involved in data acquisition and approval of the manuscript.

#### Availability of data and materials:

All data generated or analyzed during this study are included in this published article. However, some data that support the findings of this study are available from [Ribat University Hospital authority] , but restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available. Data are however available from the authors upon reasonable request and with permission of [RUH authority].

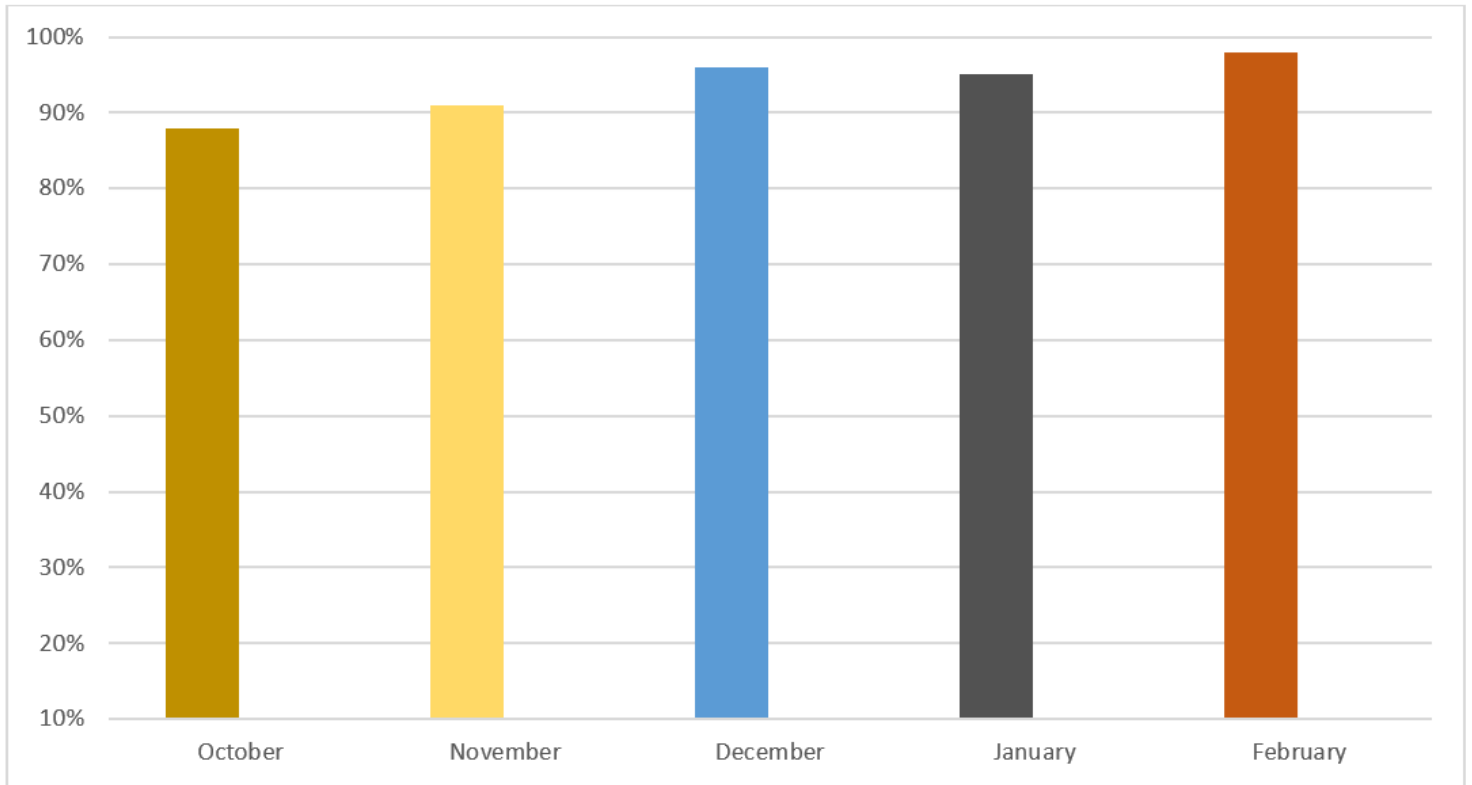


## References

- [1] Weiser TG, Haynes AB. Ten years of the surgical safety checklist: ten years of the surgical safety checklist. *Br J Surg* 2018 Jul;105(8):927e9.
- [2] Haynes AB, Weiser TG, Berry WR, Lipsitz SR, Breizat A-HS, Dellinger EP, et al. A surgical safety checklist to reduce morbidity and mortality in a global population. *N Engl J Med* 2009 Jan 29;360(5):491e9.
- [3] Ronsmans C, Graham WJ. Lancet Maternal Survival Series steering group. Maternal mortality: who, when, where, and why. *Lancet* 2006 Sep 30;368(9542):1189e200.
- [4] Weiser TG, Regenbogen SE, Thompson KD, Haynes AB, Lipsitz SR, Berry WR, et al. An estimation of the global volume of surgery: a modelling strategy based on available data. *Lancet* 2008 Jul 12;372(9633):139e44.
- [5] Melekic TB, Getahun GM. Compliance with surgical safety checklist completion in the operating room of university of gondar hospital, northwest Ethiopia. *BMC Res Notes* 2015 Dec;8(1):361.
- [6] Ambulkar R, Ranganathan P, Salunke K, Savarkar S. The World Health Organization Surgical Safety Checklist: an audit of quality of implementation at a tertiary care high volume cancer institution. *J Anaesthesiol Clin Pharmacol* 2018;34(3):7.

- [7] Lacassie HJ, Ferdinand C, Guzman S, Camus L, Echevarria GC. World Health Organization (WHO) surgical safety checklist implementation and its impact on perioperative morbidity and mortality in an academic medical center in Chile: *Medicine* 2016 Jun;95(23):e3844.
- [8] de Vries EN, Ramrattan MA, Smorenburg SM, Gouma DJ, Boermeester MA. The incidence and nature of in-hospital adverse events: a systematic review. *Qual Saf Health Care* 2008 Jun;17(3):216e23.
- [9] Schwendimann R, Blatter C, Lüthy M, Mohr G, Girard T, Batzer S, et al. Adherence to the WHO surgical safety checklist: an observational study in a Swiss academic center. *Patient Saf Surg* 2019 Dec;13(1):14.
- [10] Dinesh Hn RSR, Sk V. Surgical safety checklist implementation and its impact on patient safety. *Int Surg J* 2018 Oct 26;5(11):3640.
- [11] WHO. World Alliance for Patient Safety. WHO guidelines for safe surgery. first ed. Geneva, Switzerland: WHO; 2008.
- [12] Kable AK, Gibberd RW, Spigelman AD. Adverse events in surgical patients in Australia. *Int J Qual Health Care* 2002 Aug;14(4):269e76.
- [13] do P Tostes MF, Galvao CM. Lista de veri ~ ficaç~ ao de segurança cirúrgica: benefícios, facilitadores e barreiras na perspectiva da enfermagem. *Rev Gaúcha Enferm* 2019;40(spe):e20180180.
- [14] de Vries EN, Prins HA, Crolla RMPH, den Outer AJ, van Andel G, van Helden SH, et al. Effect of a comprehensive surgical safety system on patient outcomes. *N Engl J Med* 2010 Nov 11;363(20):1928e37.
- [15] Vats A, Vincent CA, Nagpal K, Davies RW, Darzi A, Moorthy K. Practical challenges of introducing WHO surgical checklist: UK pilot experience. *BMJ* 2010 Jan 13;340:b5433.
- [16] Conley DM, Singer SJ, Edmondson L, Berry WR, Gawande AA. Effective surgical safety checklist implementation. *J Am Coll Surg* 2011 May;212(5):873e9.
- [17] Bosk CL, Dixon-Woods M, Goeschel CA, Pronovost PJ. Reality check for checklists. *Lancet* 2009 Aug 8;374(9688):444e5.
- [18] Hales BM, Pronovost PJ. The checklist-a tool for error management and performance improvement. *J Crit Care* 2006 Sep;21(3):231e5.
- [19] Cooper K. Errors and error rates in surgical pathology: an association of directors of anatomic and surgical pathology survey. *Arch Pathol Lab Med* 2006 May;130(5):607e9.
- [20] Hancorn K, Blair S. Checklist culture: who needs changing? *BMJ* 2010;340: 90e9.
- [21] van Klei WA, Hoff RG, van Aarnhem EEHL, Simmermacher RKJ, Regli LPE, Kappen TH, et al. Effects of the introduction of the WHO "Surgical Safety Checklist" on in-hospital mortality: a cohort study. *Ann Surg* 2012 Jan;255(1): 44e9.
- [22] Agha R, Abdall-Razak A, Crossley E, Dowlut N, Iosifidis C, Mathew G, et al. STROCSS 2019 Guideline: strengthening the reporting of cohort studies in surgery. *Int J Surg* 2019 Dec;72:156e65.
- [23] Borchard A, Schwappach DLB, Barbir A, Bezzola P. A systematic review of the effectiveness, compliance, and critical factors for implementation of safety checklists in surgery. *Ann Surg* 2012 Dec;256(6):925e33.
- [24] Kasatpibal N, Senaratana W, Chitreecheur J, Chotirosniramit N, Pakvipas P, Junthasoopun P. Implementation of the world health organization surgical safety checklist at a university hospital in Thailand. *Surg Infect* 2012 Feb 1;13(1):50e6.
- [25] Lingard L, Espin S, Rubin B, Whyte S, Colmenares M, Baker GR, et al. Getting teams to talk: development and pilot implementation of a checklist to promote interprofessional communication in the OR. *Qual Saf Health Care* 2005 Oct;14(5):340e6.
- [26] Bashford T, Reshamwalla S, McAuley J, Allen NH, McNatt Z, Gebremedhen YD. Implementation of the WHO surgical safety checklist in an Ethiopian referral hospital. *Patient Saf Surg* 2014;8(1):16.
- [27] Walker IA, Reshamwalla S, Wilson IH. Surgical safety checklists: do they improve outcomes? *Br J Anaesth* 2012 Jul;109(1):47e54

# Figures



**Figure 1**

Checklist completions by month during implementation

# Surgical Safety Checklist



World Health Organization

Patient Safety  
A World Alliance for Safer Health Care

## Before induction of anaesthesia

(with at least nurse and anaesthetist)

**Has the patient confirmed his/her identity, site, procedure, and consent?**

Yes

**Is the site marked?**

Yes  
 Not applicable

**Is the anaesthesia machine and medication check complete?**

Yes

**Is the pulse oximeter on the patient and functioning?**

Yes

**Does the patient have a:**

**Known allergy?**

No  
 Yes

**Difficult airway or aspiration risk?**

No  
 Yes, and equipment/assistance available

**Risk of >500ml blood loss (7ml/kg in children)?**

No  
 Yes, and two IVs/central access and fluids planned

## Before skin incision

(with nurse, anaesthetist and surgeon)

**Confirm all team members have introduced themselves by name and role.**

**Confirm the patient's name, procedure, and where the incision will be made.**

**Has antibiotic prophylaxis been given within the last 60 minutes?**

Yes  
 Not applicable

**Anticipated Critical Events**

**To Surgeon:**

What are the critical or non-routine steps?  
 How long will the case take?  
 What is the anticipated blood loss?

**To Anaesthetist:**

Are there any patient-specific concerns?

**To Nursing Team:**

Has sterility (including indicator results) been confirmed?  
 Are there equipment issues or any concerns?

**Is essential imaging displayed?**

Yes  
 Not applicable

## Before patient leaves operating room

(with nurse, anaesthetist and surgeon)

**Nurse Verbally Confirms:**

The name of the procedure  
 Completion of instrument, sponge and needle counts  
 Specimen labelling (read specimen labels aloud, including patient name)  
 Whether there are any equipment problems to be addressed

**To Surgeon, Anaesthetist and Nurse:**

What are the key concerns for recovery and management of this patient?

This checklist is not intended to be comprehensive. Additions and modifications to fit local practice are encouraged.

Revised 1 / 2009

© WHO, 2009

Figure 2

WHO Safe surgery checklist.